RESEARCH, DEVELOPMENT & TECHNOLOGY TRANSFER
QUARTERLY PROGRESS REPORT

Wisconsin Department of Transportation
DT1241 02/2011

INSTRUCTIONS:
Research project investigators and/or project managers should complete a quarterly progress report (QPR) for each calendar quarter during which the projects are active.

WisDOT research program category: ☐ Policy research ☒ Wisconsin Highway Research Program ☐ Other ☐ Pooled fund TPF#		Report period year: 2011 ☐ Quarter 1 (Jan 1 – Mar 31) ☐ Quarter 2 (Apr 1 – Jun 30) ☐ Quarter 3 (Jul 1 – Sep 30) ☒ Quarter 4 (Oct 1 – Dec 31)
Project title: Aesthetic Coatings for Bridge Components		
Project investigator: Dr. Al Ghorbanpoor	Phone: 414-229-4962	E-mail: algh@uwm.edu
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WisDOT project ID: 0092-11-07	Other project ID:	Project start date: 10/21/2010
Original end date: 10/20/2012	Current end date: 10/20/2012	Number of extensions: 0

Project schedule status:
☒ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Project budget status:

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
$145,000.00	$30.00	$66,000.00	45%	40%

Project description:

The objectives of this study are to investigate methods and products that may be used in the aesthetic and protection coating of bridge components and to develop a guideline for cost-effective bridge coating practices. It was envisioned that a series of coating systems for both steel and concrete would be identified and tested in the laboratory to evaluate their performance under simulated environmental conditions that are similar to those experienced by bridge components in Wisconsin. After conducting a preliminary investigation and holding discussions with the Project Oversight Committee (POC), it was approved by the POC that the focused should be placed on evaluation of only steel materials due to the extensive nature of the required investigation and scope of the current study. Wisconsin bridge sites, where coating failures and problems have occurred, have been visited to identify and evaluate the structural details and other factors that have contributed to such coating failures. Upon completion of the testing and evaluation program, guidelines and specifications language will be developed for selection, application, and maintenance of such coating materials. Also, recommendations will be made to WisDOT for implementation of the results of this study.

Progress this quarter (includes meetings, work plan status, contract status, significant progress, etc.):

During this quarter the research staff has completed the preparation of the test panels. Preparation included cutting the panels to their correct size, rounding both the corners and edges on the panels, and drilling holes in the panels for coating application. Additionally, galvanized panels needed to be sandblasted before being galvanized. After the panels were galvanized they needed to have any sharp edges or high spots from the galvanization process ground down. The research staff sent out and has received the final galvanized panels from ACME Galvanization. After proper preparation the test panels are ready for the application of the final coating systems.

A meeting was held with the Vice President of Steelwind Industries. During this meeting a work plan was arranged for application of the conventional coating systems. Steelwind Industries has a large painting facility with appropriately ventilated industrial paint booths, and is where the conventional coating systems will be applied by the research staff. The research staff has received all of the coatings from the paint manufacturers and is ready for application of these coating systems.

Additionally, a meeting was set up with Armour Coatings in Germantown, Wisconsin to tour their powder coating facility and to arrange a plan for application of powder coating systems to our test panels. Two powder coating systems were selected in the final work plan approved by the POC. Two different batches of panels have already been powder coated with problems. During the powder coating process these panel experienced out-gassing, causing small air pockets in the coatings. This out-gassing occurred during the application of the top-coat and is possibly contributed to the galvanized substrate. The manufacturer is in the process of reformulating the powder coating to eliminate this out-gassing problem. More samples have been supplied to the manufacturer for additional application and testing of the new powder coating formula.

Working with John Bolka, WisDOT SE Region Structures Maintenance Engineer, the research staff identified a recently constructed bridge (B-45-21 constructed in 2011 in Ozaukee County) with aesthetic railings that have experienced problems. A visit of the bridge site was made on November 1, 2011 to evaluate the condition of the railings and the extent of the problem. The problem in the railings includes vent holes in the vertical members that are already showing signs of corrosion. It was found that several of these vent holes were blocked as an unintended outcome during the galvanization process. This will lead to entrapped moisture inside railings and causing additional future corrosion. The railings details and additional sources of problems in this bridge were identified and documented.

Anticipated work next quarter:

During the first two weeks in January 2012, the research staff will apply the conventional coating systems to test panels following the WisDOT and appropriate manufacturers recommendations. The research staff will also continue to work with the powder coating manufacturer to eliminate the out-gassing problem in the powder coating systems. After obtaining a correct formula, the test panels will be power coated at Armour Coatings facility. After application of all of the coating systems, the approved test program will begin at UWM Structural Laboratory. During the testing phase, the coated samples will be subjected to two different tests. One test will consist of UV/Prohesion/Freeze cycles and the other test will consist of Xenon arc testing. The test panels will be evaluated every two weeks for the effects of the UV/Prohesion/Freeze test and every week for the effects of Xenon arc testing. The bi-weekly and weekly evaluation will include measuring changes in color and gloss, rust creepage, holidays, dry film thickness, and scratch hardness for all test samples.

Circumstances affecting project or budget:

None.

Attach / insert Gantt chart and other project documentation

Quarters/Tasks	1	2	3	4	5	6	7	8
1. Literature Review	═══	---						
2. Survey	═══	---						
3. Interim Report	═══	---	---					
4. Laboratory Testing			═══	---	---	═══	═══	
5. Future Research						═══		
6. Guidelines/Specs						═══		
7. Draft Final report						═══	═══	
8. Final Report							═══	═══

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Staff receiving QPR:	Date received:
Staff approving QPR:	Date approved:

Test Program
(Approved by POC on September 22, 2011)

Aesthetic Coatings for Bridge Components

WHRP Project # 0092-11-07

By

Al Ghorbanpoor and Zan Leppi
University of Wisconsin-Milwaukee

September 26, 2011

Introduction

To meet the requirements of the current WHRP study entitled "Aesthetic Coatings for Bridge Components," the research team submitted a proposal on September 14, 2011 to the Project Oversight Committee (POC) and WHRP to seek approval for the proposed testing program to be performed during the remaining term of this study. The proposal included two options which were both limited to testing coating systems for only new steel applications. The proposed options included a testing program of either 10 or 12 coating systems under two color schemes. The program as approved by the POC includes the 12-coating system option that consists of a slightly smaller number of test samples for the Xenon and Mandrel testing components. Through a correspondence on September 22, 2011, the POC forwarded to the research team a final approval for the test program as detailed below.

Approved Coating Systems and Test Program

The following table shows 12 coating systems for new steel applications, along with the number of samples, and the type of tests that will be performed on these coating systems. A description of each coating system is shown in appendix "A". There will be 5 samples per coating system for the UV/Prohesion/Freeze tests (Alternate ASTM D5894), and 2 samples per coating system for Mandrel testing. For Xenon testing, there will be 3 samples per coating systems tested with the following exception. The top-coats for coatings systems #A and #M and for #C and #N are the same so we will achieve the same results by performing tests on only coating systems #A and #C. Accordingly, we will eliminate the Xenon tests for coating systems #M and #N, to meet the space limitation of the Xenon testing equipment. For all UV/Prohesion/Freeze and mandrel tests, the Federal Color Number (27038) black will be used. For the Xenon tests, the Federal Color Number (27038) black and Federal Color Number (15092) blue will be used. Accordingly, a complete Xenon testing program of a minimum of 1,000 hours will be performed for samples coated with each selected color.

Approved 12 Coating Systems

System Type and #	Number of Systems	# of 3x6x1/8 in. Samples for UV/Prohesion/Freeze Testing (Alternate ASTM D5894)	# of 2x2x1/8in. Samples for Xenon Testing (ASTM G155)	# of 4x6x1/32in. Samples for UV/Prohesion/Freeze Mandrel Testing[2]
3-Coat Polyurethane (#A, #C, #Y)	3	15	9	6
3-Coat Fluoropolymer (#B, #Z)	2	10	6	4
2-Coat (#F, #0)	2	10	6	4
Galvanized Paint (#M, #N, #X)	3	15	3[1]	6
Galvanized Powder (#AA, #AB)	2	10	6	4
Total	12	60	30	24

[1] Tests applies to coating system #X only. Note that top coats are the same for coating #A and #M and for #C and #N.

[2] 2 samples per coating system will be tested under the Mandrel tests.

Appendix "A"
(Description of Coating Systems)

3-Coat Polyurethane Systems

Coating #	Manufacture	3-Coat System	Primer /DFT(mils)	Intermediate Coat /DFT(mils)	Top Coat /DFT(mils)
A	Sherwin Williams	Polyurethane	Zinc Clad III /(3-6)	Macropoxy 646 /(3-10)	Acrolon 218 HS /(3-6)
C	Carboline	Polyurethane	Carbozinc 859 /(3-5)	Carboguard 888 /(3-5)	Carbothane 133LH /(3-5)
Y	PPG	Polyurethane	Amercoat 68HS /(3)	Amercoat 399 /(4-8)	Amercoat 450H /(2-5)

3-Coat Fluoropolymer Systems

Coating #	Manufacture	3-Coat System	Primer /DFT(mils)	Intermediate-Coat /DFT(mils)	Top-Coat /DFT(mils)
B	Sherwin Williams	Fluoropolymer	Zinc Clad III /(3-6)	Macropoxy 646 /(3-10)	Fluorokem /(2.5-3)
Z	Carboline	Fluoropolymer	Carbozinc 859 /(3-5)	Carboguard 888 /(3-5)	Carboxane 950 /(2-3)

2-Coat Systems

Coating #	Manufacture	1st Coat/DFT(mils)	2nd Coat /DFT(mils)
F	Carboline	Carbozinc 859 /(5-7)	Carboxane 2000 /(7)
O	Sherwin Williams	Corothane I Galvapac Zinc /(3-4)	Polysiloxane XLE-80 /(3-7)

Galvanized Systems with Paint Coats

Coating #	Manufacture	Tie-Coat/DFT(mils)	Top-Coat/DFT(mils)
M	Sherwin Williams	Macropoxy 646 /(2-4)	Acrolon 218 HS /(2-4)
N	Carboline	Galoseal WB /(0.5-1)	Carbothane 133LH /(3-5)
X	Wasser	MC-Ferrox B 100 /(3-5)	MC-Luster 100 /(2-4)

Galvanized Systems with Powder Coat

Coating #	Manufacture	Tie-Coat/DFT(mils)	Top-Coat/DFT(mils)
AA	Sherwin Williams	EAS6-C000 Epoxy /(1.8-3)	AAMA 2605 Fluoropolymer /(2-3)
AB	Sherwin Williams	EAS6-C000 Epoxy /(1.8-3)	AAMA 2604 Polyester /(2-3)